

1      **Claims:**

1. An open liquid-state electrochemical cell comprising an anode, a cathode, and an electrolyte being disposed between said anode and said cathode; said electrolyte containing no water-soluble polymer and comprising:
- 6      (a) a deliquescent material for keeping the open cell wet at all times; and
- (b) an ion conductive material for helping to transport ions between said anode and said cathode; wherein said electrolyte is exposed to open air.
2. The cell as in claim 1, wherein said electrolyte is carried by or impregnated in a porous structure.
3. The cell as in claim 2, wherein said porous structure is selected from the group consisting of a ceramic membrane, a polymer membrane, a non-woven fabric, a woven fabric, and a sheet of porous paper.
- 11      4. The cell as in claim 1, wherein said electrolyte comprises a water-insoluble but water-compatible or hydrophillic polymer selected from the group consisting of a lightly cross-linked polymer, a hydrogel, an interpenetrating network, a semi-interpenetrating network, and combinations thereof.
- 16      5. The cell as in claim 1, wherein said anode comprises an anode active material selected from the group consisting of magnesium, aluminum, titanium, manganese, zinc, chromium, iron, nickel, tin, and combinations thereof.
6. The cell as in claim 5, wherein said anode active material is in the form of a fine powder, a thin fiber, a thin film, or a combination thereof.
- 21      7. The cell as in claim 1, wherein said anode or said cathode comprises carbon powder, graphite platelet, and/or graphite fiber.

- 1      8. The cell as in claim 1, wherein said cathode comprises an inert material not soluble in or reactive with said electrolyte; said inert material being selected from a group consisting of a metal oxide, sulfide, phosphide, arsenide, selenide, telluride, and combinations thereof.
9. The cell of claim 1, wherein the ion conductive material is selected from the group consisting of zinc-chloride, zinc-bromide, zinc-fluoride, potassium-hydroxide, and combinations thereof.
- 6      10. The cell of claim 1, wherein the deliquescent material is selected from the group consisting of zinc chloride, calcium chloride, magnesium chloride, lithium chloride, calcium bromide, potassium biphosphate, sodium formate, potassium acetate, phosphorous oxide, ammonium acetate, sodium acetate, sodium silicate, magnesium acetate, potassium silicate, magnesium sulfate, aluminum oxide, calcium oxide, silicon oxide, zeolite, barium oxide, cobalt chloride, 11 bentonite, montmorillonite clay, silica gel, molecular sieve, monohydric compounds, polyhydric compounds, metal nitrate salt, sodium ethyl-sulfate organic salt, hydrogels, and combinations thereof.
- 11      11. The cell as in claim 1, further comprising an anode current collector in physical contact with said anode and/or a cathode current collector in physical contact with said cathode.
- 16      12. The cell as in claim 1, further comprising two terminals in physical contact with said anode and said cathode, respectively.
13. A battery comprising a plurality of electrochemical cells with at least one of said electrochemical cells comprising an open liquid-state cell as defined in claim 1.
- 21      14. The cell as in claim 1, wherein said anode, cathode and electrolyte are thin layers so that the cell is flexible.
15. The cell as in claim 3, wherein said porous structure is a thin layer having two opposite surfaces with a first surface in physical contact with said anode and a second surface in physical

1       contact with said cathode.

16. The cell as in claim 15, wherein both anode and cathode are thin layers with a thickness smaller than 20  $\mu\text{m}$  so that the cell is flexible.

17. A functional device comprising a flexible thin-layer open liquid-state electrochemical cell as defined in claim 14 for providing said device with electrical power for its operation.

6       18. A functional device comprising a flexible thin-layer open liquid-state electrochemical cell as defined in claim 15 for providing said device with electrical power for its operation.

19. The device of claim 17, wherein said device includes a substrate and at least one electronic component attached to said substrate, said at least one electronic component is for performing a sensible function.

11       20. The device of claim 19, wherein said substrate is selected from the group consisting of a greeting card, a business card, a radio frequency identification tag, a package of a food product, and a printed matter.

16       21. The device of claim 17, wherein said electronic component is selected from the group consisting of an audio device, a visual device, a power switch, a light-emitting diode, a timer, a voltage regulator, an amplifier, an antenna, a transceiver, a sensor, an actuator, an integrated circuit, a memory, an electrically active ink, an electrically non-active ink, and combinations thereof.

21       22. The device of claim 18, wherein said device includes a substrate and at least one electronic component attached to said substrate, said at least one electronic component is for performing a sensible function.

23. The device of claim 22, wherein said substrate is selected from the group consisting of a

1      greeting card, a business card, a radio frequency identification tag, a package of a food product,  
and a printed matter.

24. The device of claim 18, wherein said electronic component is selected from the group  
consisting of an audio device, a visual device, a power switch, a light-emitting diode, a timer, a  
voltage regulator, an amplifier, an antenna, a transceiver, a sensor, an actuator, an integrated  
6      circuit, a memory, an electrically active ink, an electrically non-active ink, and combinations  
thereof.